Technical Possibilities and Environmental Approaches for the Future

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Overview

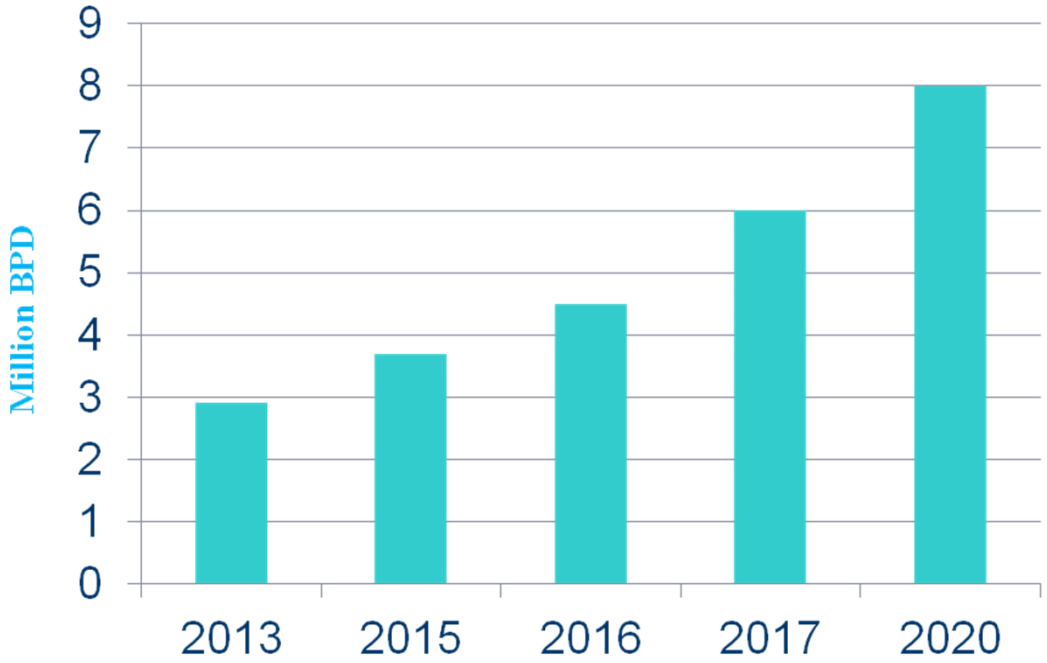
Introduction

* Iraq, OPEC's second-largest oil producer, plans to boost crude output
* To make crude oil for manufacturing and exporting a series of complex processes are conducted
* Three major refineries in Iraq which including Midland Refineries Company, South Refineries Company and North Refineries Company
* Many Units will be installed in the near future, such as Isomerization Unit, Continuous Catalytic Regeneration Unit, Fluid Catalytic Cracking, etc.

Iraq's Oil Reserves Stood at 143 Billion Barrel

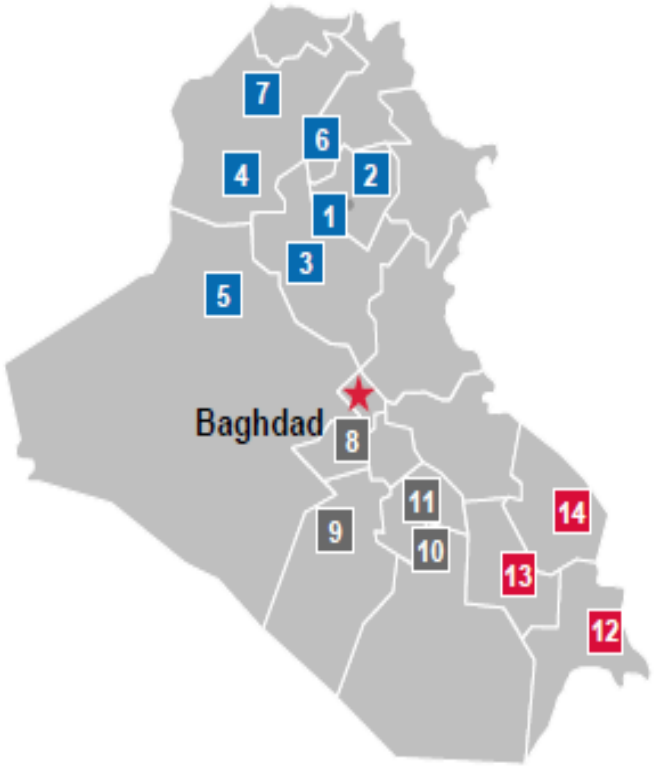
The Iraqi oil reserves increased by 30% from previous estimates to become granted reserve according to estimates by experts of the ministry and investment companies, 143 billion barrel.

The Future of the Iraqi Oil Production



In 2017 will see a significant increase in oil production up to 6 million BPD

Iraq has 14 Refineries



No	Refinery	Design Capacity KBPD	Available Capacity KBPD
1	**Beiji**	310	250
2	Kirkuk	30	25
3	Al Siynia	30	20
4	Al Jazeera	20	
5	Hadithah	16	10
6	Qaiyarah	34	28
7	Kisik	20	16
8	**Daura**	185	120
9	Najaf	30	27
10	Samawah	30	27
11	Diwaniya	20	18
12	**Basrah**	140	130
13	Nassiriya	30	24
14	Missan	30	20
TOTAL		**925**	**712**

North Refineries Company(NRC)

Beiji refinery was built in 1980 with capacity of 310 KBPD
Consists of:-

A- Salahuddin 1 Refinery with capacity of 70 KBPD

B- North Refinery with capacity of 150 KBPD

C- Salahuddin 2 Refinery with capacity of 70 KBPD

D- Al Nasriya Refinery with capacity of 20 KBPD

E- Lube Oil Plant – Two Trains with capacity of 125 Kton of different oil stocks per train per year

North Refineries Company(NRC)

Exterior Refineries consists of:-

A- Kirkuk Refinery (1973) with capacity of 30 KBPD

B- Siynia Refinery (1978) with capacity of 30 KBPD

C- Kisik Refinery (1982) with capacity of 20 KBPD

D- Qaiyarah Refinery (1983) with capacity of 34 KBPD

E- Hadithah Refinery (1951) with capacity of 16 KBPD

F- Al jazeera Refinery (1984) with capacity of 20 KBPD

Midland Refineries Company (MRC)

MRC consists of Daura Refinery and exterior Refineries

Daura Refinery was established in 1955

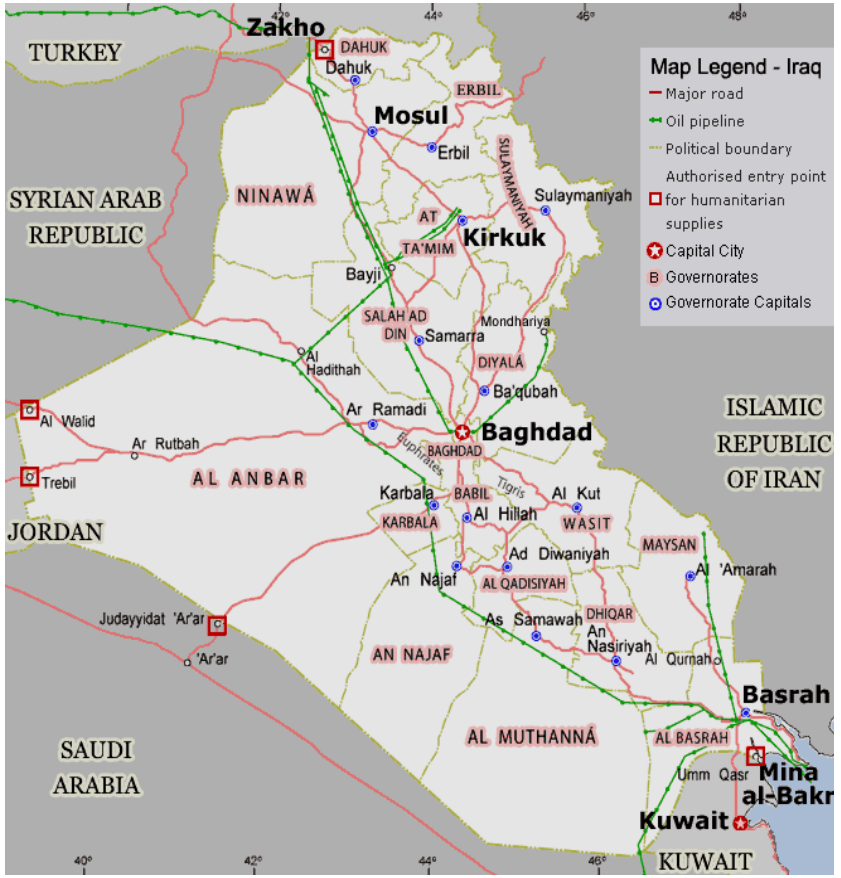
There are five main boards at the Daura Refinery as follows:

A- Light Oils Board
B- Lube Board
C- Powerhouse Board
D- Maintenance Board
E- Technical and Engineering Board

Midland Refineries Company (MRC)

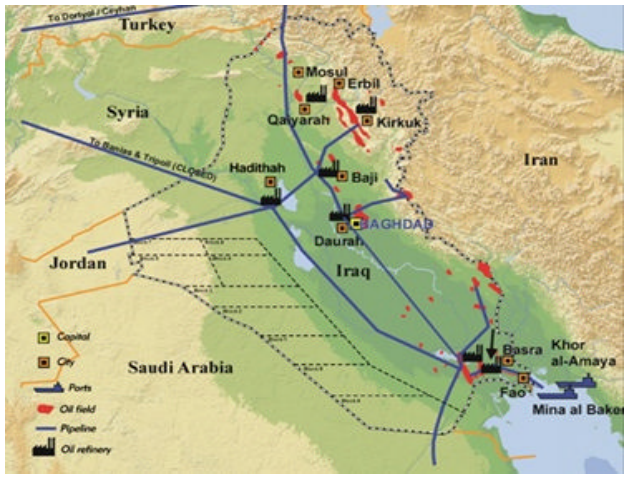
Exterior Refineries

No.	Refinery Name	Design Capacity (KBPD)
1-	Najaf	30
2-	Samawah	30
3-	Diwaniya	20



Daura Refinery consumes Basrah and Kirkuk Crude Feedstock

Inputs	Input Type
Feedstock	Basrah Crude Kirkuk Crude East Baghdad Crude Naft Khana Crude



Challenges:

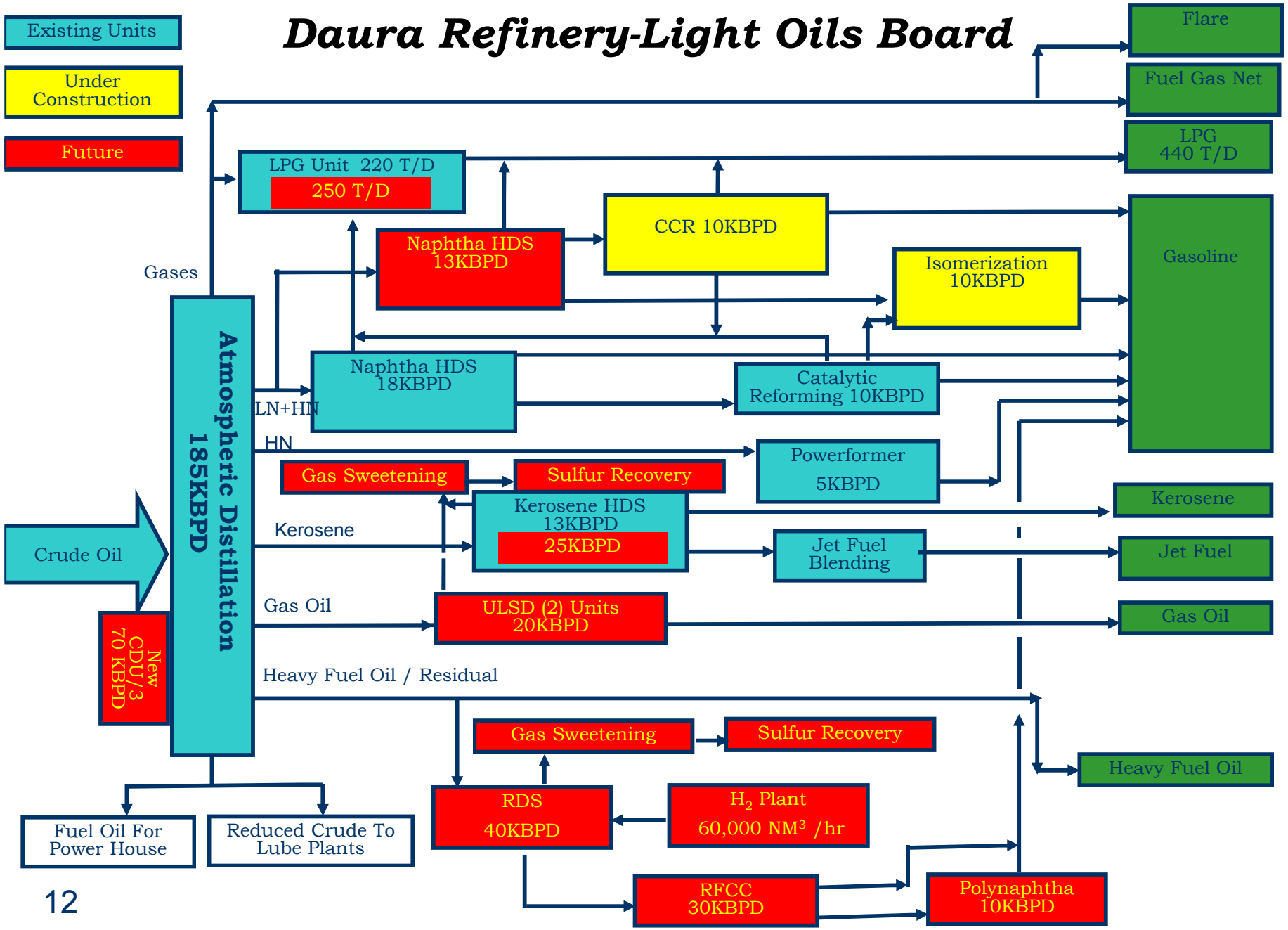
Shortage of crude oil , many feedstock supply networks and pipelines have been damaged causing inconsistent supply , examples of these are:

1-Mainteance of pipeline (kirkuk) and strategic pipeline (Basrah)

2- 2004- till now (terrorist)

3- Transportation - line capacity

Daura Refinery-Light Oils Board



Crude Distillation Units (CDU)

Capacity: 185 KBPD

Consist of:

Combination Units(CDU1&3): 48 KBPD:

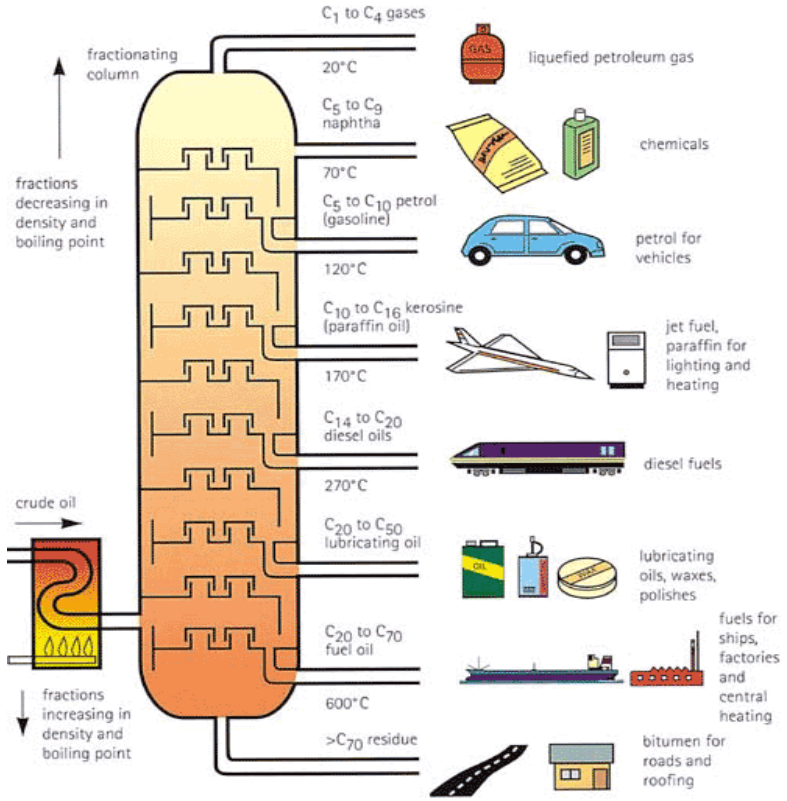
Old CDU No.1 was built in 1959

Old CDU No. 3 was built in 1956

New Crude Distillation Units No.1 &2 were installed in 2009 and 2010 respectively

Capacity: 70 KBPD for each

Contractor: Prokop Company



Kerosene Hydrotreating Unit

* Kerosene Hydrotreating Kerosene (K.H.T.) was built in 1969

* Contractor: Technoexport (Czechoslovakia Company)

* KHT was designed with capacity of 13241 BPSD in order to reduce sulphur compounds in raw kerosene from 3000 ppm to 150 ppm. This is done through mixing kerosene with H_2, and heating them up to 315 ^{0}C and then passed to reactors containing catalyst. After that, kerosene is sent to a tower to increase the flash point

* Aviation Turbine Kerosene (A.T.K.) is produced as well in this unit. In fact, A.T.K. is a kerosene with special specifications, such as the flash point should be not less than 41^{0}C, while the end point should be not more than 249 ^{0}C. In addition, chemicals should be injected into treated kerosene like: anti static, anti oxidant and additive K

Reforming Complex

* It was built in 1978

* The complex consists of the following units:

1- HDT Unit **Capacity:** 18 KBPD

Licence: IFP/ French Company

Contractor: TPL/ Italic Company

2- Reformer Unit **Capacity:** 10 KBPD

Licence: IFP/ French Company

Contractor: TPL/ Italic Company

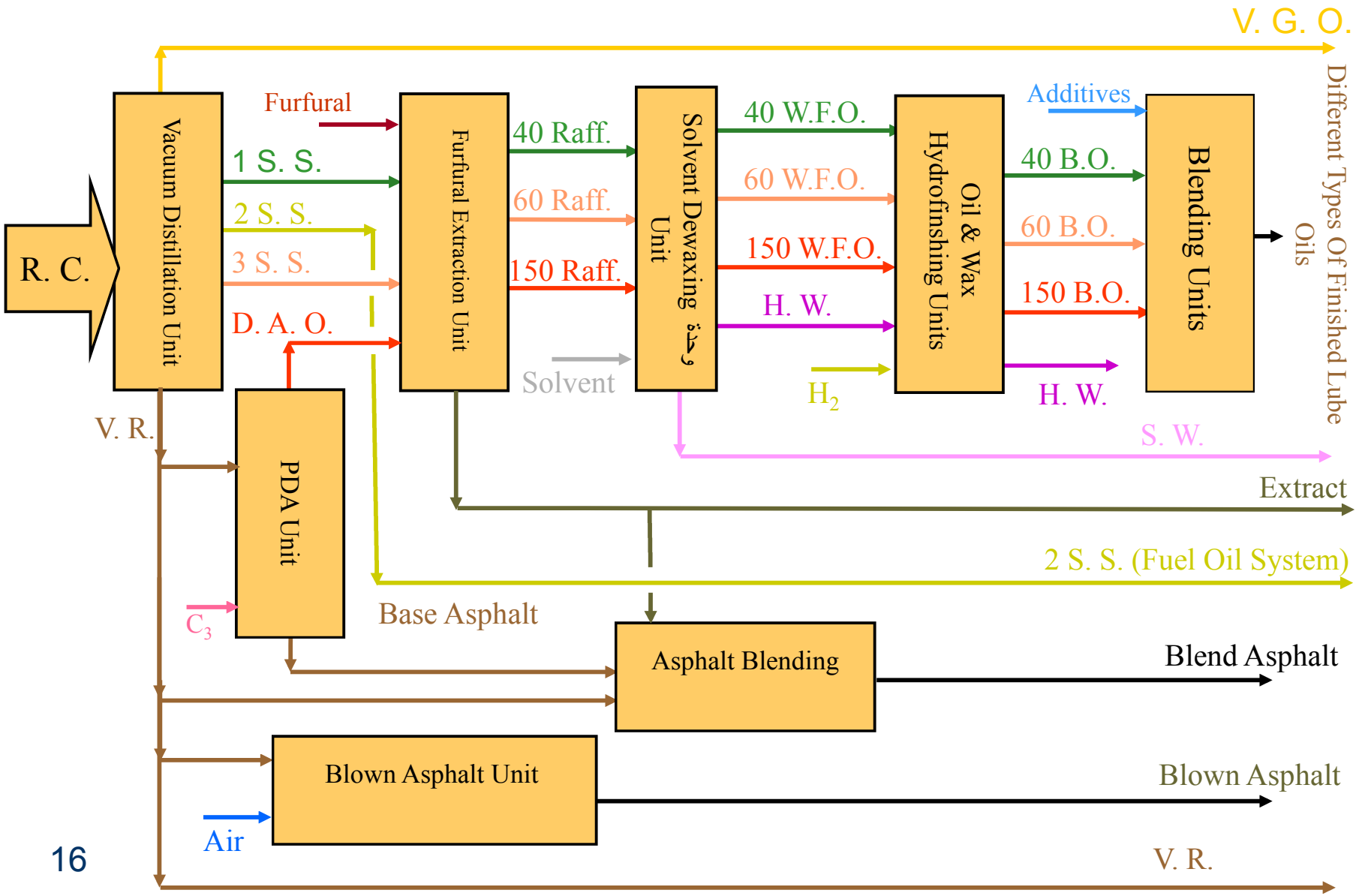
Catalyst Type: PR-9 (Bimetallic)

3- Liquefied Petroleum Gases (LPG) Unit

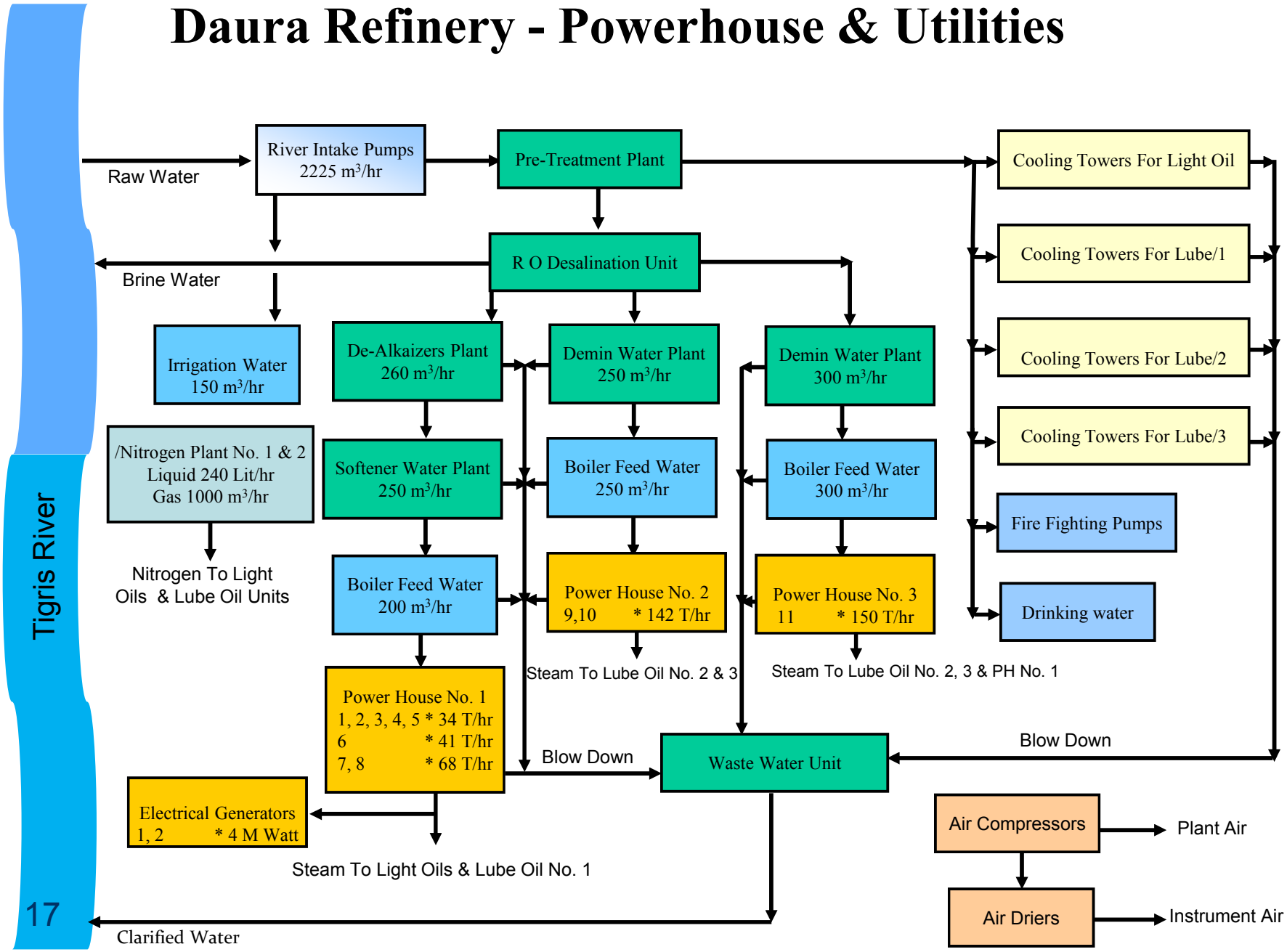
Capacity: 220 Ton/D

Engineering and Contractor: TPL /Italic Company

Daura Refinery - Lube Oil Plant



Daura Refinery - Powerhouse & Utilities



South Refineries Company (SRC)

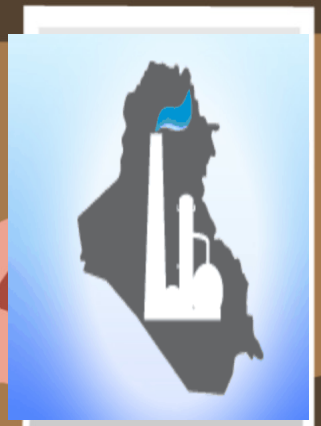
SRC was established in 1969

Capacity : 210 KBPD

CDU No.1 (70 KBPD) was built in 1969
CDU No.2 (70 KBPD) was built in 1976
New CDU (70 KBPD) is built in 2013

Lube Plant was installed in 1982

Challenges Facing Daura Refinery



Gasoline

Current fuel quality levels especially that of gasoline is poor; Daura refinery plans to improve quality , for instance Isomerization will be on stream soon

Challenges:

- Current quality levels especially for gasoline are low - e.g., low RON, high sulfur
- Daura refinery would need to align with evolving domestic and international quality standards
  - Investments in upgrading and desulfurization capacity to improve quality
  - New operating units planned are being designed to meet Euro specifications
- Iraq stands to benefit if fuel specifications are improved to international standards

Average Refinery Product Quality Levels

Product	Specification Dimension	Daura Refinery Actual
Gasoline	RON	82
	Sulfur Content (ppm)	40
	RVP (kg/cm^2)	0.64
	MMT Content (g/liter)	~0.15
Gasoil/Gasoil	Cetane No.	56
	Sulfur Content (ppm)	~9,500
	Flash Point (C^0)	75
Fuel Oil	Sulfur Content (ppm)	(40,000) 4% wt
	Flash Point (C^0)	>100
	Viscosity c.st at 50 ^{0} C	225

Gas Oil &Fuel Oil

Raw gas oil that come out from CDU is sent to finished tanks which is used to operate different types of diesel vehicles including diesel machines

Challenges:

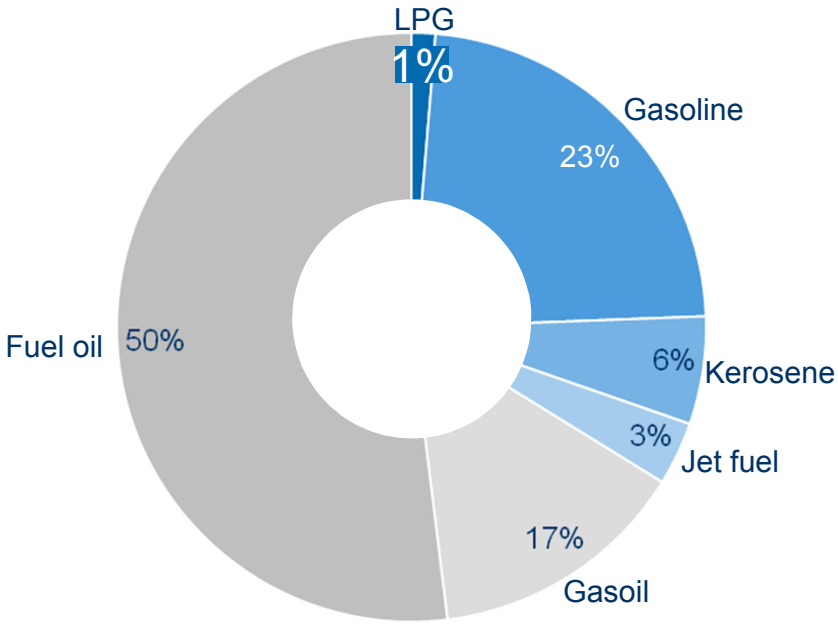
- Light gas oil and heavy gas oil do not have hydrotreating units
- Bottlenecks on supply routes and storage networks

Fuel oil is used as fuel for different factories and for power generation, part of it is sent to lube plant to produce lubes, wax and asphalt. In fact, fuel oil represents nearly half of production (Operating units design 50% FO)

Challenges:

- No new tech to conversion
- FO delivery problem
- Tank farm not enough

Daura Refinery Product Mix



Daura Refinery Inputs

Inputs	Input Type
Power	National Grid Supplied Captive Power Generation Gas Generator

Challenges:

In spite of gas generation has been installed at the Daura refinery which is a great significance for the refinery and covers electrical power needed to run it on an ongoing basis and without interruption to maintain streamline the work of the operational units on a regular basis and the surplus is given to the national grid.

Other Challenges

No.	Item	Challenges
1-	**Catalysts**	❖ The procedures to get the catalyst from outside Iraq facing several difficulties, including the method of shipping to Iraq because of the security situation ❖ The methods used in the filling reactors are quite old due to the lack of special equipment for that, particular dense loading
2-	**Environmental Pollutions**	Due to high and rapid development in the oil industry at the last century, many different problems had occurred, one of them is the environmental pollution in all elements of the environment, such as water, soil and air, which began to raise serious questions that need a rapid solutions, a good example of this is HSSE (Health, Safety, Security, and Environment) should be considered
3-	**Spare Parts**	Refinery shutdown due to unplanned maintenance and the lack of original spare parts for some of major equipment
4-	**Crude Oil Specifications**	Daura Refinery and operation units have been designed to work on a crude oil with API (33-35) With the arrival of heavy crude oil, the operation units suffer from several problems, as follows: ❖Affects the efficiency of furnaces due to the presence of harmful metals, such as vanadium ❖Get more heavy oil products of the desired light products ❖The high sulfur content significantly can be found in all raw oil products ❖Corrosion in the oil equipment is occurred

Environmental Aspects of Refining

* Pollution in the world has increased dramatically

* It may be defined as the contamination of the environment due to human activity. It can be divided into three parts: air, water and solid pollution

* One of the main reasons for that is industrial technology

*Operating units produce different kinds of emissions to the air, water, and soil

* The main air contaminants from the crude oil refinery are CO2, SOx, NOx, CO, particulates, and volatile organic compounds (VOCs)

Environmental Aspects of Refining

* Crude oil production and refining generate gases and chemical waste which should be treated; otherwise it may become a contaminant

* Contaminants may be divided into two parts: primary and secondary

Source ⟶ Primary Pollutant ⟶ Secondary Pollutant

* The first type is a contaminant which is released directly from the source

Examples of these are: sulphur dioxide (SO2), carbon oxides (COx), and Nox

$$[C]_{petroleum} + O_2 \longrightarrow CO_2$$

$$[S]_{petroleum} + H_2 \longrightarrow H_2S + \text{hydrocarbons}$$

* Secondary contaminants have important environmental impacts, such as smok and the formation of acid rain

$$SO_3 + H_2O \longrightarrow H_2SO_4 \quad \text{(sulphuric acid)}$$

$$NO_2 + 2H_2O \longrightarrow HNO_3 \quad \text{(nitric acid)}$$

Legislation and Regulation in Iraq

* Many countries in the world began applying pollution control regulations

* A good example of this is the USA where the emission of sulphur dioxide declined by 30% from 1970 to 1992

* In Iraq which faces difficult circumstances, there is no any kind of legislation or regulation framework in order to take care of our environment

* Control of SOx and NOx emissions by clean air legislation is leading to a change for the better in air quality. So, the environmental policy should be taken into account to achieve this target.

Conclusions and Recommendations

* The existing refineries infrastructure is very old and huge incentives are being offered for investment in existing and new projects.

* New operating units should be installed at the Iraqi Refineries

* Isomerization Unit is the most important units need to be taken into account
  a) Provides high octane 88 RON
  b) Lowest investment cost
  c) Will accept high feed benzene levels

*It is widely believed that the safety principle should be applied in forbidding (TEL) from gasoline in order to prevent any healthy risk

*Legislation for cleaner fuels needs to be established and primarily by concern for the environment and people's health not by requests from oil refineries

* It is recommended, before the legislation is implemented, Best Available Technique (BAT) should be considered

Units Execution Plan

No.	Projects		Capacity
1	**Isomerization (BPSD)**		10
2	**CCR (BPSD)**		10
3	**H2 Plant (NM³/hr)**		4000
4	**ULSK (KBPD)**		25
5	**ULSD**		
	5-a	ULSD (KBPD)	20
	5-b	H2 Plant (NM³/hr)	20,000
6	**RFCC**		
	6-a	RDS (KBPD)	40
	6-b	RFCC(KPBD)	30
	6-c	H2 Plant (NM³/hr)	60,000
	6-d	Polynaphtha (KBPD)	10
	6-e	SRU(T/D)	2*125

Units Execution Plan

7	**New CDU/3**		
	7-a	New CDU/3 (KBPD)	70
	7-b	H.D.T. (KBPD)	18
	7-c	Reformer Unit (KBPD)	10
	7-d	Isomerizition Unit (KBPD)	10
	7-e	GRU (TPD)	200
	7-f	SRU + TGT (TPD)	200
	7-g	SWS	
8	**LPG Unit(TPD)**		250

North Refineries Company(NRC)

New Projects in the future:-

A- New Kirkuk Refinery with capacity of 150 KBPD

B- FCC Unit with capacity of 55 KBPD

C- Six Boilers with capacity of 400 Ton/hr (under construction)

D- Power Generation Plant (85 MW)

E- LPG Unit with capacity of 400 TPD

Green Refinery

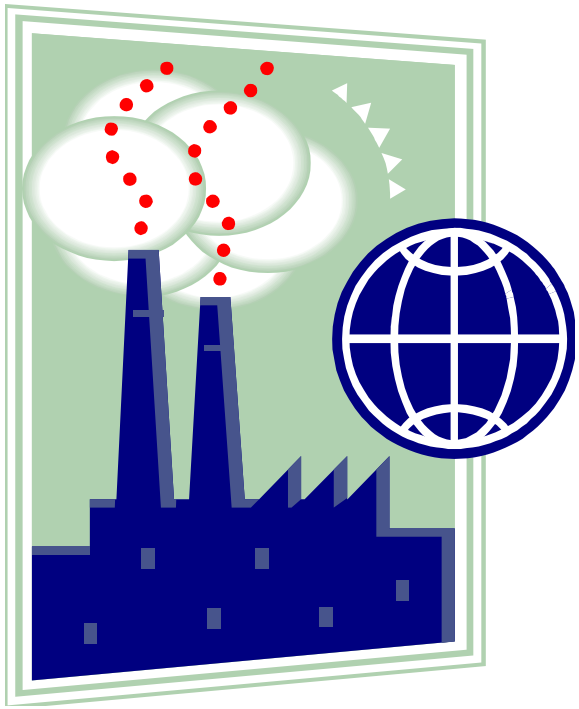
Green refining may be defined as a number of activities with a main target by reducing emissions such as, **greenhouse gases, CO2, and wastes.** Additionally, as a result minimizing the industry's negative impact on the environment. The following areas should be taken into account:

1-Technologies for CO^2 Reduction
2- Improving Energy Efficiency
3- Low-Carbon Fuels

Karbala Refinery

Conversion Refinery is designed with capacity of 140 KBPD which including:

- Crude Oil Distillation Unit 140 KBPD
- Naphtha Hydrotreating Unit (NHT) 40 KBPD
- Reforming Unit 20 KBPD
- Fluid Catalytic Cracking (FCC) 30 KBPD
- Isomerization Unit 12 KBPD
- Kerosene Hydro Treating Unit 20 KBPD
- Ultra Low Sulfur Diesel Unit (ULSD) 28 KBPD
- Hydrogen Production Unit 50000 m^3/hr
- Alklization Unit with 3 KBPD
- Vacuum Distillation Unit 7.2 KBPD
- Vacuum Gasoline Hydrotreating Unit 36 KBPD
- LPG Recovery Unit 900 T/D.
- Sulfur Recovery Unit 350 T/D
- Integrated Tanks & Services Area.
- Utilities & Service Supplies.



Flare System

Daura Refinery has 2(two) existing flare stacks. The old stack handled the flare gas of 3 old CDUs, Powerfromer unit and Kerosene unit. The other stack was built in 1980 with Naphtha HDS, Reformer & LPG Recovery and handled the flare gas coming from 2 new CDUs, Naphtha HDS & reformer and LPG recovery. The both stacks connected with pipe line each other to share the flaring gas

The capacity of existing stack built in 1980 is 205 ton/hr with smokeless capacity of 9 ton/hr. The type of this flare is guyed wire support (GW)

Flaring Loss Reduction

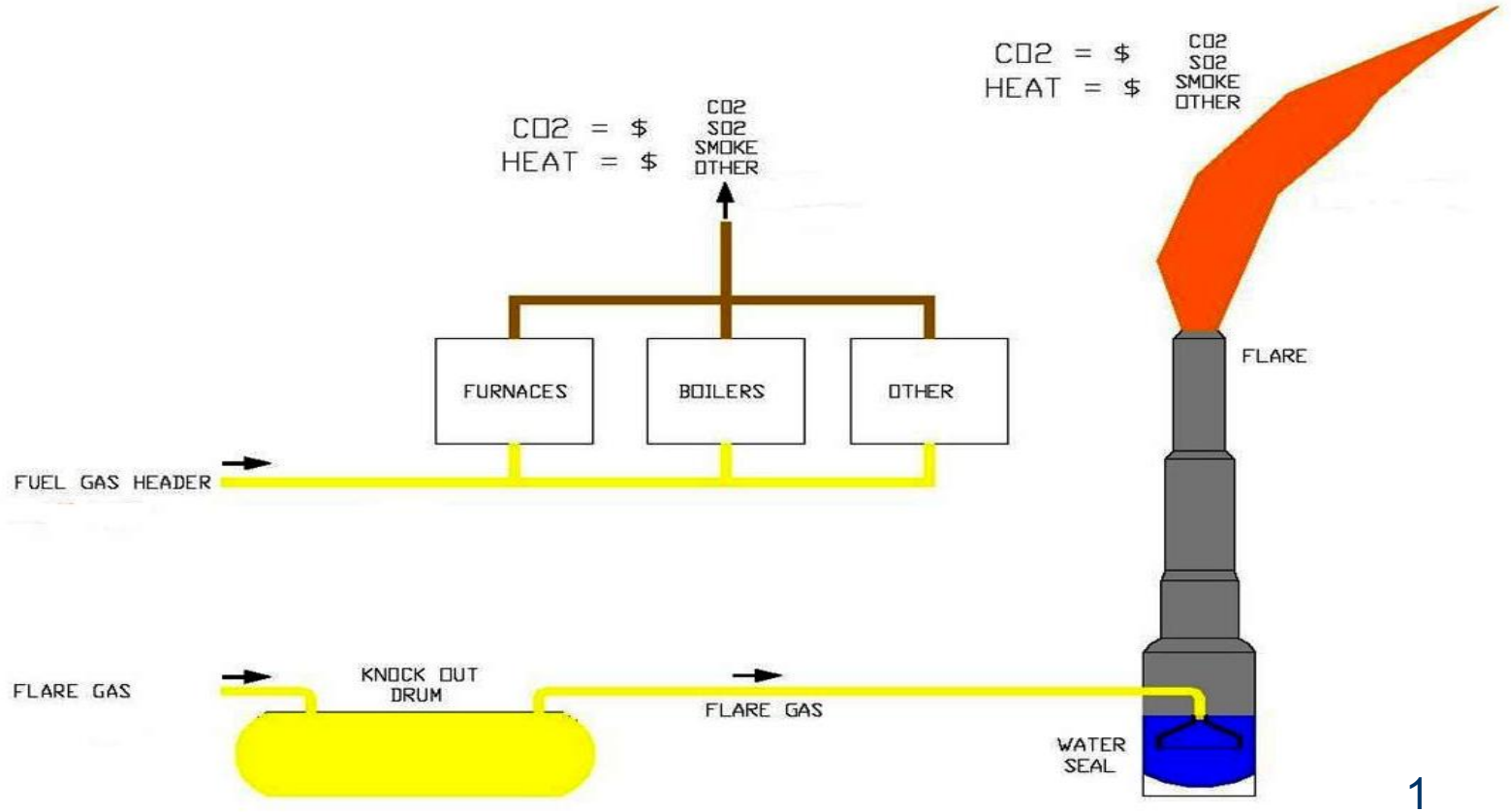
MRC signed a contract with SK E&C (Korean Company) in order to prepare and provide MRC the detailed engineering package for the flaring system.

The new flare stack will have the capacity of 900 ton/hr.

Flaring Loss Reduction Construction Package has been finished and submitted to MRC and this package is equivalent to MR (Material Requisition), which contains the datasheet and specifications of new flare

EPC of new flare will be announced soon

Problem Definition



Problem Solving

FUEL USAGE REDUCED
CO2 EMISSIONS REDUCED

OTHER EMISSIONS REDUCED